WHAT IS CLAIMED IS:

1. An apparatus, comprising:

a metallic seed applicable to grow at least one crystal by directional solidification of a molten metal, said starter seed has a portion for receiving the molten metal thereon and at least one internal passageway adapted for the passage of a heat transfer media.

2. The apparatus of claim 1,wherein said metallic seed is formed of a superalloy material and adapted to grow a crystal from a molten superalloy material.

3. The apparatus of claim 1, wherein said at least one passageway defines a plurality of passageways adapted for the passage of a heat transfer media.

4. The apparatus of claim 1, wherein said seed has a first end and an opposite second end, and wherein said portion is formed on said first end and includes melt acceleration means for changing phase from a solid state to a liquid state in response to thermal conditions.

5. The apparatus of claim 4, wherein said acceleration means defines a portion having a reduced cross-sectional area.

6. The apparatus of claim 5, wherein said acceleration means has a generally roof shape.

7. A metallic seed crystal for the use in solidification of a molten metal to an article, comprising:

a metallic member having a melt end and a base end with a melt portion and a non-melt portion therebetween, said base end defines a first surface adapted to contact a heat sink to transfer heat from said member; and

said melt portion formed at said melt end and adapted for receiving molten metal thereagainst, said melt portion has an unmelted state with a cross sectional area less than the area of said first surface and a melted state wherein said melt portion has a cross sectional area substantially equal to said first surface so as not to restrict heat transfer to said base end.

8. The metallic seed of claim 7, wherein said member is formed of a superalloy material.

9. The metallic seed of claim 7, which further includes at least one internally formed passageway, said at least one internally formed passageway adapted for the passage of a heat transfer media.

10. The metallic seed of claim of claim 7, wherein said metallic member has a fine grained columnar structure.

11. An apparatus for exchanging heat with a metallic starter seed during the directional solidification of a molten metal, comprising:

at least one member for mechanically gripping the metallic starter seed and maintaining a heat transfer path with the starter seed as the metal material solidifies; and

a heat transfer sink connected with said at least one member for removing heat therefrom.

12. The apparatus of claim 11, wherein said at least one member defines a pair of mechanical members disposed in abutting thermally conductive arrangement with the starter seed.

13. The apparatus of claim 11, wherein said heat transfer sink is an active device.

14. The apparatus of claim 13, wherein said at least one member includes a passageway therein, and said heat transfer sink defining a heat transfer media passing through said heat transfer passageway.

15. The apparatus of claim 14, wherein said heat transfer media is a liquid metal.

16. The apparatus of claim 11, wherein said at least one member defines a pair of members, each of said pair of members has a jaw portion abutting and in thermal conductivity with the starter seed, each of said jaw portions has a heat transfer passageway in fluid communication with said heat transfer sink.

17. The apparatus of claim 16, wherein said heat transfer sink defines a fluid.

18. The apparatus of claim 16, wherein the seed has a heat flux that is varied over time, and a first thermal gradient associated with nucleation and a second thermal gradient associated with crystal growth, and wherein said second thermal gradient is greater than said first thermal gradient.

19. The apparatus of claim 11, which further includes a heat transfer source coupled with said at least one member, said heat transfer source adapted for transferring energy to said at least one member to locally heat the metallic starter seed.

20. The apparatus of claim 19, wherein said heat transfer source includes a electrical power source for passing current through said at least one member, whereby the metallic seed is resistant heated.

21. The apparatus of claim 11, which further includes a casting mold, and wherein the starter seed is positioned within the casting mold.

22. The apparatus of claim 21, wherein the starter seed includes a first surface adapted for receiving the molten metal thereagainst, and which further includes means for precisely locating and holding said first surface at a predetermined location.

23. The apparatus of claim 22, wherein the starter seed includes a second surface, and wherein said means for precisely locating and holding includes a member contacting said second surface.

24. The apparatus of claim 22, wherein the starter seed includes a precision locating feature formed thereon, and wherein said means for precisely locating and holding is defined by a portion of said at least one member, wherein said portion interengages with said precision locating feature formed on the starter seed.

25. The apparatus of claim 11, wherein said heat transfer sink is a passive device.

26. The apparatus of claim 12, wherein the starter seed includes a pair of locating features formed thereon, and wherein a portion of each of said pair of mechanical

members is engageable with one of said locating features to position the starter seed at a predetermined location.

27. An apparatus, comprising:

a crucible having a discharge;

a vacuum furnace having said crucible positioned therein for melting metal material within the crucible;

a metallic starter seed;

a casting mold having an opening adapted to receive said starter seed and an internal cavity for receiving the molten metal material discharged from said discharge, said starter seed is positioned within said opening and contactable by the molten metal material received in said internal cavity; and

a heater coupled with said starter seed to selectively add energy to said starter seed during a first period, and wherein the starter seed is joined to the metal poured in said cavity and heat is withdrawn through said starter seed during the directional solidification of the metal material within said cavity.

28. The apparatus of claim 27, which further includes at least one member gripping said starter seed, said at least one member establishing a heat transfer path with said starter seed.

29. The apparatus of claim 28, wherein said at least one member includes a heat transfer passageway therein for the passage of a heat transfer media, and whereby heat is conductively transferred from the molten metal within the cavity to said starter seed, and the circulation of said heat transfer media within said heat transfer passageway creates a thermal gradient within said starter seed and directional solidification of the molten metal within the cavity.

30. The apparatus of claim 29, wherein the heater is manipulated to vary a thermal gradient of said seed between a first time and a second time.

31. An apparatus, comprising:

a vacuum furnace having a mechanical housing;

a crucible positioned within said mechanical housing, said crucible has a discharge orifice;

a heater within said housing and proximate said crucible for melting metal material within the crucible;

a casting mold having a cavity for receiving the molten metal material discharged through said orifice, and a portion for positioning a starter seed within said mold in contact with the melted metal material said cavity; and

said starter seed has a metallic body with at least one passageway therein for the passage of a heat transfer media.

32. The apparatus of claim 31, wherein said mold is insulated to prevent heat loss, and wherein the heat from said molten metal material is withdrawn through said starter seed, whereby the molten metal material is directionally solidified.

33. The apparatus of claim 32, wherein the directional solidification of the molten metal material forms a single crystal component.

34. The apparatus of claim 11,which further includes a heat transfer source connected with said at least one member and adapted to increase locally heat the metallic starter seed.

35. The apparatus of claim 34, wherein said heat transfer source is adjusted to decrease the thermal gradient through the seed in a first mode, and said heat transfer sink is adjusted to increase the thermal gradient through the seed in a second mode.

36. The apparatus of claim 11, which further includes a heat transfer source connected with said at least one member and adapted to heat the metallic starter seed, and wherein said heat sink and said heat source are operable at the same time.

37. An apparatus for pouring a molten metal, comprising:

a crucible having a bottom wall member with an aperture formed therethrough;

an upstanding first tube positioned within said crucible and having a first end located around said aperture and coupled to said bottom wall member and another second end that is closed, said first tube having at least one entrance for allowing the passage of molten metal from said crucible to said first tube;

an upstanding second tube located within said first tube and having one end coupled to said bottom wall member and in fluid communication with said aperture and another end defining an inlet from said first tube, said second tube has a first cavity adapted for receiving a volume of molten metal therein; and

a passageway extending along said second tube for the passage of the molten metal from said at least one entrance to said inlet.

38 The apparatus of claim37, which further includes a nozzle in fluid communication with said aperture, said nozzle adapted to deliver a substantially vertical stream of molten metal.

39. The apparatus of claim 37:

which further includes a nozzle coupled with said aperture and in fluid communication with said first cavity of the second tube, said nozzle has an inlet adapted to receive molten metal and an outlet adapted to discharge molten metal; and

which further includes a mechanical housing having a first chamber at a first pressure and a second chamber at a second pressure, and wherein said crucible is located within said first chamber and said outlet of the nozzle is located within said second chamber.

40. The apparatus of claim 39, which further includes pressure differential means for creating a pressure differential between said first chamber and said second chamber, wherein upon said pressure differential means causing said first pressure to be greater than said second pressure the molten metal within said crucible flows through said at least one entrance and into said passageway along said second tube.

41. The apparatus of claim 40, wherein said pressure differential means includes a supply of pressurized gas in fluid communication with said first chamber, and wherein said supply of pressurized gas is controlled to increase said first pressure in said first chamber.

42. The apparatus of claim 40, wherein said pressure differential means includes a quantity of unmelted metal stock extending into said first chamber, and wherein said unmelted metal stock is advanced into the molten metal within said crucible to increase said first pressure.

43. The apparatus of claim 40, wherein said pressure differential means includes a vacuum in fluid communication with said second chamber, said vacuum being operable to reduce said second pressure.

44. The apparatus of claim 39, wherein a difference is size between said outlet and said at least one entrance allows the volumetric flow rate of molten metal through said at least one entrance to be substantially greater than the volumetric flow rate of molten metal through said outlet.

45. The apparatus of claim 44, wherein said at least one entrance defines a plurality of entrances.

46. The apparatus of claim 39, wherein said nozzle has an upstanding portion that extends into said second tube, and wherein a second cavity is defined between said second tube and said upstanding portion of said nozzle, wherein said second cavity is adapted to receive molten metal and heat said upstanding portion of said nozzle.

47. The apparatus of claim 37, wherein said first cavity defines a metering cavity holding a predetermined volume of molten metal.

48. The apparatus of claim 40, which further includes a sensor positioned proximate said outlet, said sensor detects an initial flow of molten metal from said outlet and communicates with said pressure differential means to stop creating a pressure differential between said first chamber and said second chamber.

49. The apparatus of claim of claim 39, wherein said nozzle and said first tube and said second tube are parallel to one another, and wherein said at least one entrance is located adjacent said first end of the first tube.

50. A method for pouring molten metal into a casting mold within a vacuum furnace, comprising:

providing a crucible with a discharge aperture and a pour assembly located within the crucible, the pour assembly including an upstanding outer tube positioned around an upstanding inner tube, the inner tube is in fluid communication with the discharge aperture;

melting a metal material within the crucible to a liquid state;

flowing the liquid state metal from the crucible into a cavity defined between the outer tube and the inner tube;

overfilling the cavity so that liquid state metal flows into and fills the inner tube;

stopping the filling of the inner tube; and

discharging the liquid state metal from the inner tube.

51. The method of claim 50:

wherein in said providing the outer tube has a plurality of inlet apertures;

wherein said flowing involves passing the molten metal through the plurality of inlet apertures; and

which further includes increasing the pressure differential between the discharge aperture and the molten metal within the crucible.

52. The method of claim 51, wherein said increasing includes applying a positive pressure to the molten metal within the crucible.

53. The method of claim 52, wherein said applying a positive pressure includes advancing the unmelted metal material stock into the molten metal within the crucible.

54. The method of claim 50, wherein said flowing includes creating a pressure differential between the molten metal within the crucible and the cavity between the outer tube and the inner tube, and wherein the pressure on the molten metal in the crucible is greater than the pressure within the cavity between the outer and inner tube.

55. The method of claim 54, wherein said overflowing of the cavity includes maintaining a pressure differential between the molten metal in the crucible and the cavity between the outer tube and the inner tube, and wherein the pressure on the molten metal in the crucible is greater than the pressure within the cavity between the outer and inner tube.

56. The method of claim 55, wherein said stopping occurs when the pressure in the cavity between the inner and outer tube is greater than the pressure of the molten metal within the crucible.

57. The method of claim 50, which further includes providing a nozzle in flow communication with the discharge aperture, and which further includes flowing a quantity of molten metal into the cavity to heat at least a portion of the nozzle.

58. The method of claim 50, which further includes sensing the discharge of molten metal from the discharge aperture, and upon said sensing said stopping occurring.

59. The method of claim 50, which further includes providing a casting mold adapted to receive the molten metal, and which further includes connecting the discharging of the molten metal with the casting mold in a confined passageway.

60. The method of claim 59:

which further included providing a nozzle in flow communication with the discharge aperture and extending therefrom; and

which further includes positioning the nozzle adjacent an inlet to the casting mold prior to said discharging.

61. The method of claim 60, wherein said discharging delivers a substantially vertical stream of molten metal.

62. The method of claim 60, which further includes moving the casting mold to align the casting mold inlet with the nozzle.

63. An apparatus, comprising:

a mechanical housing;

a crucible adapted to receive a metal material therein, said crucible positioned within said housing;

a heater positioned adjacent said crucible for heating the crucible and melting the metal received within said crucible; and

a pressure controlled precision pour assembly positioned within said crucible, said pour assembly has an outer cavity with at least one entrance for the passage of melted metal material from said crucible to said outer cavity and an exit for the passage of melted metal material to an inner metering cavity, and wherein said pour assembly has a first state wherein said inner metering cavity receives melted metal material from said outer cavity until said inner metering cavity is full and a second state wherein the flow of melted metal material to said inner cavity is stopped and the melted metal material within said inner metering cavity is discharged.

64. The apparatus of claim 63, wherein said crucible includes a discharge opening, and wherein in said second state the melted metal material within said inner metering cavity flows through said discharge opening.

65. The apparatus of claim 64, which further includes a nozzle coupled to said crucible and in fluid communication with said discharge opening.

66. The apparatus of claim 65:

wherein said mechanical housing has a first chamber and a second chamber, and wherein said crucible is located within said first chamber; and

said second state discharges molten metal when the pressure in said second chamber is greater than the pressure within said first chamber.

67. The apparatus of claim 65:

wherein said crucible has a bottom wall member, and wherein said discharge opening is formed in said bottom wall member;

wherein said pressure controlled precision pour assembly includes an outer upstanding tube coupled to said bottom wall member and positioned around said discharge opening;

wherein said pressure controlled precision pour assembly includes an inner upstanding tube coupled to said bottom wall member and positioned around said discharge opening,

wherein said inner upstanding tube is positioned within said outer upstanding tube, and said outer cavity is located between said tubes, and wherein said inner metering cavity is positioned within said inner tube.

68. The apparatus of 67, wherein a difference in area between said nozzle outlet and said at least one entrance allows the volumetric flow rate of molten metal through said at least one entrance to be substantially greater than the volumetric flow rate of molten metal through said outlet.

69. An apparatus for dispensing a molten metal, comprising:

a mechanical housing having a first chamber with a first pressure and a second chamber with a second pressure;

a crucible positioned within said first chamber of the mechanical housing and adapted to receive a stock of unmelted metal material therein;

a heater positioned adjacent said crucible and adapted for heating the crucible and at least a portion of the unmelted metal material therein to a molten metal state, wherein said crucible holds the volume of molten metal melted by the heater therein;

a tube having a first end and a second end with a flow communication passageway therebetween, said first end positioned beneath a surface of the volume of molten metal within said crucible and a second end positioned in fluid communication with said second chamber and defining a discharge aperture; and

a pressure differential device within said first chamber and acting on the volume of molten metal to increase the pressure thereof and cause molten metal to flow through said passageway and out of said second end, said pressure differential device is defined by at least a portion of the unmelted metal material.

70. The apparatus of claim 69, wherein said pressure differential device defines a consumable member that is replenished by additional unmelted metal material.

71. The apparatus of claim 70, wherein said first chamber has an aperture therein adapted for the passage of the stock of unmelted metal material, and a substantially fluid tight seal is formed around the stock.

72. An apparatus for pouring a molten metal, comprising:

a mechanical housing with a bottom wall member and an interior volume adapted to hold a molten metal; and

a molten metal delivery member having a first molten metal inlet end adapted to receive molten metal from below the surface of the molten metal within the interior volume and a second molten metal outlet end with a passageway therebetween, at least a portion of said delivery member positioned within said mechanical housing, said passageway has a first passageway portion and a second passageway portion and a inflection portion wherein the direction of molten metal flow changes, in a first discharge mode a first direction of

molten metal flow within said first passageway portion is from said molten metal inlet to said inflection portion and from said inflection portion through said second passageway portion in a second direction to said outlet.

73. The apparatus of claim 72, wherein said first passageway portion and said second passageway portion and said inflection portion define a substantially U shape.

74. The apparatus of claim 72, wherein said inflection portion is above the surface of the molten metal within said interior volume.

75. The apparatus of claim 74, wherein the pressure of the molten metal within the inflection portion is greater than the pressure at either of said molten metal inlet or said molten metal outlet.

76. The apparatus of claim 75, wherein said molten metal delivery member is integrally formed.

77. The apparatus of claim 72, wherein said second passageway portion defines a metering cavity.

78. The apparatus of claim 72 wherein the cross-sectional area of said passageway varies between said first inlet end and said second outlet end.

79. The apparatus of claim 78, wherein said first passageway portion tapers prior to said inflection portion.

80. The apparatus of claim 78, wherein said first passageway has a substantially frustum-conical shape part prior to said inflection portion.

81. A casting mold, comprising:

a free form fabricated ceramic shell, said ceramic shell having a thin first outer wall defining a cavity therein that is adapted for receiving a molten metal;

a container having a second outer wall with an inner surface, wherein said shell is positioned within said container and spaced from said inner surface; and

at least one support member substantially filling the space between said first outer wall and said inner surface and reinforcing said shell.

82. The casting mold of claim 81, wherein said ceramic shell includes a starter seed receiving inlet.

83. The casting mold of claim 81, wherein said ceramic shell is an integral structure.

84. The casting mold of claim 83, wherein said integral structure is consistent with fabrication by a three-dimensional printing technique.

85. The casting mold of claim 83, wherein said integral structure is consistent with fabrication by a selective laser activation technique.

86. The casting mold of claim 81, wherein said container and said ceramic shell are connected in interference fit.

87. The casting mold of claim 86, wherein said ceramic shell includes a top member portion and a bottom member portion, and wherein said container defines a tube, and further wherein a portion of said inner surface is in an interference fit with said top member portion and said bottom member portion.

88. The casting mold of claim 87, wherein said container is formed of a material selected from one of a porous ceramic, a ceramic fibermatt and a thermal barrier coated metallic.

89. The casting mold of 81, wherein said at least one support member defines a plurality of support members filling said space between said first outer wall and said inner surface.

90. The casting mold of claim 89, wherein said plurality of support members defined by ceramic media members.

91. The casting mold of claim 90, wherein said plurality of support members has a size within a range of about 0.010 to about 0.100 inches.

92. The casting mold of claim 81, wherein said ceramic shell has a generally airfoil shape portion, and wherein said cavity includes a generally air foil shape.

93. The casting mold of claim 81:

wherein said ceramic shell defines an integral structure having an inlet adapted for receiving a metallic starter seed;

wherein said ceramic shell includes an integral top member and an integral bottom member portion, and wherein a portion of said inner surface is disposed in an interference fit with said top member and said bottom member; and

wherein said at least one support member defines a plurality of ceramic member filling said space between said first outer wall and said inner surface.

94. The casting mold of claim 93, which further includes at least one supplemental heater positioned within said container.

95. The casting mold of claim 81, wherein said ceramic shell is substantially dense.

96. A casting mold, comprising:

a refractory member having a first outer wall with an inner surface;

an integral multi-wall ceramic shell having a second outer wall with a thickness less than about 0.040 inches and a molten metal receiving cavity therein, said shell includes a starter seed receiving inlet portion opening into said molten metal receiving cavity, and wherein said shell is positioned within said refractory member; and

at least one support member positioned within said container between said first outer wall and said second outer wall to abut and reinforce said outer wall of the shell.

97. The casting mold of claim 96, wherein said refractory member and said ceramic shell are coupled in interference fit.

98. The casting mold of claim 97, wherein said at least one support member defines a plurality of support members positioned within said refractory member.

99. The casting mold of claim 96, wherein said refractory member is a thick walled fibrous ceramic member with an interior cavity, and wherein said at least one support member defines a plurality of ceramic members filling the space between said second outer wall and said inner surface.

100. The casting mold of claim 96, wherein said ceramic shell has a first portion with a first density and a second portion with a second density, and wherein said first density is greater than said second density.

101. The casting mold of claim 96, which further includes a mold heater positioned within said refractory member.

102. The casting mold of claim 96, wherein said ceramic shell is substantially dense.

103. The casting mold of claim 96, wherein said ceramic shell and said at least one support member defines a structure that can withstand a casting head pressure of about three to about twenty-four inches of nickel.

104. A method, comprising:

providing a mold having an internal cavity adapted for the receipt of molten metal therein, the cavity has a top portion, bottom portion and side portion;

insulating the ceramic shell to minimize heat transfer through said side portion;

placing the mold within an environmental control chamber;

filling the cavity with molten metal to form a casting defined by the cavity; and

directionally solidifying the molten metal within the mold by withdrawing energy from one end of the casting.

105. The method of claim 104, wherein said providing defines forming the mold with a free form fabrication technique.

106. The method of claim 105 wherein the free form fabrication is a select laser activation technique.

107. The method of claim 104, which further includes putting the mold within a mold container, and said insulating includes depositing a plurality of ceramic media pieces between the mold and the mold container.

108. The method of claim 104, which further includes coupling a metallic starter seed with the mold, the starter seed is in fluid communication with the molten metal during said filling, and wherein said directionally solidifying includes withdrawing the heat from the casting through the starter seed via a conductive heat transfer pathway.

109. The method of claim 108, which further includes melting a portion of the metallic starter seed during said filling.

110. The method of claim 104, wherein the molten metal is a superalloy, and wherein said directionally solidifying is occurring at a rate of about 60 inches per hour.

111. The casting mold of claim 87, wherein said container is formed of a metallic material.

112. The casting mold of claim 93, wherein said container defines a tube.

113. The casting mold of claim 93, wherein said container defines a cup.

114. A method, comprising:

providing a casting mold having a plurality of layers of a material bonded together to define a cavity for receiving a molten metal material therein and an exit in communication with the cavity;

orienting the casting mold at an inclination;

rotating the casting mold to free any material located within the cavity and not bonded to one of the plurality of layers of material; and

passing the material located within the cavity out of the cavity and through the exit.

115. The method of claim 114, which further includes moving the casting mold along a pathway.

116. The method of claim 115, wherein said moving is occurring simultaneous with said rotating.

117. The method of claim 114, wherein said rotating is unidirectional.

118. The method of claim 114, wherein said rotating is bi-directional.

119. The method of claim 114, which further includes gas scrubbing the inner surface of the plurality of layers of material bonded together to define the cavity.

120. The method of claim 114, wherein the inclination is at an acute angle.

121. The method of claim 114, which further includes placing a plug in the exit after said passing of the material from the cavity.

122. The method of claim 114, wherein said rotating is within a range of about 0.1 revolutions per minute to about 2 revolutions per minute, and wherein the casting mold is rotated between about fifteen minutes and two days.

123. The method of claim 122, wherein the casting mold is rotated about two hours.

124. The method of claim 114:

which further includes moving the casting mold along a pathway;

wherein at least a portion said moving and said rotating are occurring simultaneously; and

wherein said orienting orients the casting mold at an acute angle.

125. The method of claim 114, which further includes placing the casting mold within a mold container.

126. A method, comprising:

forming an integral ceramic shell by three dimensional printing, the ceramic shell includes a plurality of layers of a ceramic material bonded together to define a cavity therein for receiving a molten metal material and at least one exit in fluid communication with the cavity;

orienting the ceramic shell at an inclination;

rotating the ceramic shell about a first axis to free ceramic material located within the cavity that is not bonded to one of the plurality of layers of material; and

passing the material located within the cavity out of the cavity and through the at least one exit.

127. The method of claim 126, which further includes moving the ceramic shell along a predetermined pathway.

128. The method of claim 126, wherein said moving is substantially linear.

129. The method of claim 126, wherein said rotating about an axis is unidirectional.

130. The method of claim 126, which further includes providing a casting mold tube, and which further includes positioning the ceramic shell within the casting mold tube prior to said orienting.

131. The method of claim 126, which further includes passing a gas through the cavity to scrub the inner surface of the plurality of layers defining the cavity.

132. The method of claim 126, which further included inverting the ceramic shell to facilitate removal of the ceramic material within the cavity.

133. The method of claim 126, which further includes providing a first gear coupled with the ceramic shell, and which further includes engaging the first gear with a driven second gear to cause said rotating.

134. The method of claim 114, which further includes drying the plurality of layers.

135. The method of claim 134, wherein said drying is occurring during a preheating act of the mold.

136. A system, comprising:

a vacuum furnace;

a crucible positioned within said vacuum furnace and having a discharge hole;

a heater positioned within said vacuum furnace for melting the metal material within said crucible;

a metallic starter seed;

a dispenser located within said crucible and around said discharge hole, said dispenser has an outer portion with at least one entrance for the passage of molten metal from said crucible and an exit spaced from said at least one entrance for the passage of molten metal to an inner reservoir, and wherein said inner reservoir receives molten metal from said outer portion until said inner reservoir reaches a full state, and at said full state the

flow of molten metal to said inner reservoir is stopped and the molten metal within said inner reservoir is discharged through said discharge hole;

an integral free form fabricated ceramic shell having a first opening for receiving the molten metal discharged through said discharge hole and a second opening for receiving said starter seed, said ceramic shell positioned within and connected with a mold container; and

a heat transfer pathway connected with said starter seed for the removal of heat from said starter seed, said heat transfer pathway remains connected with said starter seed as the molten metal within said ceramic shell is directionally solidified.

137. The system of claim 136, which further includes a heater operatively coupled with said starter seed to selectively heat said starter seed.

138. The system of claim 136, wherein said ceramic shell has a thin outer wall, and which further includes a plurality of supporting members within said mold container and abutting said thin outer wall, wherein said plurality of supporting members reinforcing said ceramic shell.

139. The system of claim 138, wherein said ceramic shell and mold container define a casting mold capable of withstanding casting pressures up to about twenty-four inches of nickel.

140. The system of claim 136, which further includes a nozzle coupled to said crucible and in fluid communication with said discharge hole, and wherein said nozzle is positionable in close proximity with said first opening of the ceramic shell.

141. The system of claim 140, wherein said nozzle and said ceramic shell define a structure having a substantially closed passageway therebetween during the passage of molten metal from said dispenser to said ceramic shell.

142. The system of claim 136, wherein the discharge of molten metal from said discharge hole is controlled by a pressure differential.

143. The system of claim 136, wherein said heat transfer passageway includes at least one member that mechanically grips said starter seed, said at least one member is conductively connected with said starter seed.

144. The system of claim 143, wherein said at least one member defines a pair of members that mechanically grip said starter seed.

145. The system of claim 136 wherein said starter seed has a surface adapted for receiving molten metal thereon, and which further includes a means for locating said surface at a predetermined location within said ceramic shell.

146. The system of claim 136:

wherein said ceramic shell and said mold container define a casting mold, said ceramic shell has a thin outer wall, and which further includes a plurality of ceramic members positioned within said mold container and abutting an outer surface of said thin outer wall, and wherein said plurality of supporting members mechanically reinforcing said ceramic shell;

which further includes a nozzle coupled to said crucible and disposed in fluid communication with said discharge hole, and wherein said nozzle is positionable in close proximity with said first opening of the ceramic shell; and

wherein the discharge of molten metal from said discharge hole is controlled by a pressure differential;

wherein said heat transfer pathway is formed in a pair of conductive members that mechanically grip said starter seed; and

wherein said starter seed has a surface adapted for receiving molten metal thereon, and which further includes at least one locating member contacting said starter seed to position said surface at a predetermined location within said ceramic shell.

147. A system, comprising:

a crucible adapted for holding a metal material;

a mechanical housing having a first chamber and second chamber, said crucible located within said first chamber;

a heater located within said first chamber to heat the metal material within said crucible to a molten metal state;

a metallic starter seed having a body member including a melt portion;

a pressure controlled molten metal delivery system positioned within said crucible, said molten metal delivery system including a member with a passageway therethrough for the passage of molten metal, said passageway having a first portion adapted to receive molten metal therein from beneath the surface of the molten metal within the crucible and a second portion defining a molten metal discharge;

a casting mold including a free form thin ceramic shell located within and an outer mold container, said casting mold includes at least one reinforcement member between said ceramic shell and said outer mold container for supporting said ceramic shell, wherein said ceramic shell including a cavity to receive the molten metal material discharged from said molten metal discharge and an opening to receive the metallic starter seed, wherein said melt portion positioned within said opening to enable said melt portion to be contacted by molten metal, said cavity has a top and a bottom;

a heat transfer device mechanically connected with said starter seed for removing heat from the starter seed to cause directional solidification from said bottom to said top of the metal material within said cavity.

148. The system of claim 147:

wherein said crucible with molten metal therein is located within said first chamber and said casting mold is located within said second chamber; and

which further includes a pressurized gas source, said source is coupled in fluid communication with said first chamber, and wherein said source is controlled to flow a quantity of pressurized gas into said first chamber and increase the pressure therein to a pressure greater than the pressure in said second chamber, wherein molten metal is discharged from said discharge.

149. The system of claim 147:

wherein said crucible with molten metal therein is located with said first chamber and said casting mold is located within said second chamber; and

which further includes a pressurizing member adapted to increase the pressure on the molten metal within the crucible, at least a portion of said pressurizing member is located within said first chamber and is moveable between a first state wherein molten metal is discharge from said discharge and a second state wherein the flow of molten metal from said discharge is stopped.

150. The system of claim 149, wherein said first state includes moving said pressurizing member into said molten metal.

151. The system of claim 150, wherein said pressurizing member is defined by a bar of the metal material to be melted within said crucible.

152. The system of claim 147, wherein said heat transfer device withdrawing sufficient energy to enable the molten metal to be directionally solidified at a rate of about sixty inches hour.

153. A system for casting a product, comprising

a vacuum furnace having a first chamber and a second chamber;

a crucible positioned within said first chamber, said crucible has a discharge hole;

a heater positioned within said first chamber adjacent said crucible and adapted for heating the metal material to a molten metal state;

an integral free form ceramic casting shell having a molten metal receiving cavity therein and a starter seed receiving portion, said ceramic casting shell positioned within a shell container and reinforced by a plurality of reinforcing members located within said shell container and at least a portion abutting said ceramic shell;

dispensing means located within said crucible for discharging molten metal into said ceramic casting shell;

a metallic starter seed having a melt portion, at least a portion of said starter seed positioned within said starter seed receiving portion of said ceramic shell, said melt portion oriented to receive molten metal thereon from said dispensing meanst; and

directional solidification means coupled with said starter seed for directionally solidifying the molten metal within said casting shell.

154. The apparatus of 153, which further includes a seed heater operatively coupled with metallic starter seed to adjust the temperature of said starter seed.

155. The apparatus of claim 153, wherein said integral free form ceramic shell was formed by a selective laser activation technique.

156. The apparatus of claim 153, wherein said integral free form ceramic shell was formed by a three-dimensional printing technique.

157. The apparatus of claim 153, which further includes a meltable member positioned within said ceramic shell and contactable by said molten metal passing from dispensing means to said molten metal receiving cavity, whereby the molten metal melts said meltable member and mixes with the molten metal in said molten metal receiving cavity.

158. The system of claim 153, wherein said molten metal dispensing means is controlled by applying a positive pressure within said first chamber.

159. A method, comprising:

building a integral ceramic casting mold shell by a free form fabrication technique, the casting mold shell has an internal cavity adapted to receive a molten metal;

reinforcing the ceramic casting mold shell;

positioning a metallic starter seed within the ceramic casting mold shell, the metallic starter seed is positioned to receive molten metal therein;

filling the internal cavity with molten metal; and

withdrawing heat through the metallic starter seed to directionally solidify the molten metal within the internal cavity.

160. The method of claim 159, wherein said withdrawing includes mechanically connecting at least one heat transfer member with the starter seed to maintain a conductive heat transfer path with the metallic starter seed during the directional solidification.

161. The method of claim 160, which further includes flowing a heat transfer media through a passageway within the at least one heat transfer member.

162. The method of claim 159, wherein the metallic starter seed includes a passageway formed therein, and wherein said withdrawing includes flowing a heat transfer media through the passageway.

163. The method of claim 159, which further includes selectively heating the metallic starter seed.

164. The method of claim 163, wherein the selectively heating includes passing a current through the metallic starter seed to resistant heat the seed.

165. The method of claim 159, wherein said building includes three-dimensional printing of layers to form the ceramic casting mold shell.

166. The method of claim 165, which further includes removing any unbonded material within the internal cavity prior to said filling.

167. The method of claim 159, wherein said building includes selective laser activation of layers to form the ceramic casting mold.

168. The method of claim 159, which further includes creating a build file to define the casting mold shell built in said building.

169. The method of claim 159, which further includes providing a meltable member, the meltable member is positioned within the casting mold shell at a location wherein molten metal melts the meltable member and mixes with the molten